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Proposed Re-evaluation Decision PRVD2016-23

# Antisapstain Use of 2-(Thiocyanomethylthio) benzothiazole (TCMTB)

*(publié aussi en français)*

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# Background

This document forms part of a wider assessment of health and environmental risks of the active ingredients used in antisapstain and joinery wood treatments.

In 2004, Health Canada's Pest Management Regulatory Agency (PMRA) completed a re-evaluation of the occupational risks for the antisapstain uses of three antisapstain active ingredients: 2-(thiocyanomethylthio) benzothiazole (TCMTB), copper-8-quinolinolate (copper-8), and disodium octaborate tetrahydrate (boron). The occupational exposure and risk assessments were conducted for workers at lumber processing facilities such as sawmills. The re-evaluation decision (RRD2004-08) identified the need for additional data to refine the occupational risk assessments and required that a product stewardship program (with follow-up monitoring) be implemented for all registered antisapstain chemicals to reduce exposure to workers. In addition, RRD2004-08 indicated that an assessment of the environmental risks of antisapstain products would be communicated in separate documents.

In response to the 2004 decision, the registrants of antisapstain products, the Sapstain Industry Group, developed a product stewardship program, referred to as the Exposure Reduction Program (ERP). This program was approved by PMRA, implemented for all antisapstain products and follow-up occupational exposure field monitoring was conducted. The ERP included additional personal protective equipment and engineering controls, which have shown to be effective in reducing worker exposure.

There are currently five active ingredients registered as joinery wood preservatives. These active ingredients are: boron, dodecyl dimethyl ammonium chloride (DDAC), iodocarb, propiconazole and tebuconazole. Considering that the occupational exposure scenarios for antisapstain and joinery uses are similar, and in the interest of efficiencies and consistency in decision making, occupational risk assessments were also conducted for all joinery products using the Sapstain Industry Group's follow-up field monitoring exposure data.

Altogether, seven active ingredients registered as antisapstain and/or joinery wood preservatives required updated health and environmental risk assessments. These active ingredients are: TCMTB, copper-8 quinolinolate, boron, DDAC, iodocarb, propiconazole, and tebuconazole. The occupational risk assessments for these seven antisapstain and joinery active ingredients have been updated using current use information, current toxicology endpoints and the follow-up field monitoring exposure data. The environmental risk assessments have been conducted using available data and information.

There is no joinery use registered for TCMTB. This document addresses the health and environmental risk assessments for the antisapstain use of TCMTB. The re-evaluation of the antisapstain and joinery uses of the remaining active ingredients listed above will be communicated in separate documents.

# Overview

## Proposed Re-evaluation Decision for the Antisapstain Use of 2-(Thiocyanomethylthio) benzothiazole (TCMTB)

The PMRA has completed the health and environmental risk assessments for the antisapstain use of 2-(thiocyanomethylthio) benzothiazole (TCMTB). Under the authority of the *Pest Control Products Act*, the PMRA is proposing continued registration of the antisapstain use of TCMTB in Canada.

An evaluation of available scientific information found that the use of TCMTB antisapstain products is not expected to pose risks of concern to human health or the environment when used according to the proposed revised label directions. As a requirement for the continued registration of antisapstain products containing TCMTB, new risk-reduction measures are proposed.

This proposal affects the antisapstain end-use products containing TCMTB registered in Canada. Once the final re-evaluation decision is made, the registrant will be instructed on how to address any new requirements.

This Proposed Re-evaluation Decision is a consultation document[1] that summarizes the science evaluation for TCMTB and presents the reasons for the proposed re-evaluation decision. It also proposes additional risk-reduction measures to further protect human health and the environment.

The information is presented in two parts. The Overview describes the regulatory process and key points of the evaluation, while the Science Evaluation provides detailed technical information on the assessment of TCMTB.

The PMRA will accept written comments on this proposal up to 90 days from the date of publication of this document. Please forward all comments to Publications (please see contact information indicated on the cover page of this document).

## What Does Health Canada Consider When Making a Re-evaluation Decision?

The key objective of the *Pest Control Products Act* is to prevent unacceptable risks to people and the environment from the use of pest control products. Health or environmental risk is considered acceptable[2] if there is reasonable certainty that no harm to human health, future generations or the environment will result from use of, or exposure to, the product under its conditions or proposed conditions of registration. Conditions of registration may include special

1 "Consultation statement" as required by subsection 28(2) of the *Pest Control Products Act*.

2 "Acceptable risks" as defined by subsection 2(2) of the *Pest Control Products Act*.

precautionary measures on the product label to further reduce risk. The Act also requires that products have value[3] when used according to the label directions.

To reach its decisions, the PMRA applies hazard and risk assessment methods as well as policies that are rigorous and modern. These methods consider the unique characteristics of potentially sensitive subpopulations in both humans (for example, children) and organisms in the environment (for example, those most sensitive to environmental contaminants). These methods and policies also consider the nature of the effects observed and the uncertainties present when predicting the impact of pesticides. For more information on how the PMRA regulates pesticides, the assessment process and risk-reduction programs, please visit the Pesticides and Pest Management section of Health Canada's website.

For more details on the information presented in this overview, please refer to the Science Evaluation of this consultation document.

## What is TCMTB?

TCMTB is used as a wood preservative for sapstain control. There is no joinery use registered for this active ingredient. In addition to its use as an antisapstain, TCMTB is also registered as a biocide in industrial processes waters (pulp and paper mills and cooling water systems) and as a preservative in a number of materials (pulp and paper products and additives, leather and hides, paint, coatings, sealants, metal working fluids, wallpaper adhesives).

Antisapstain products are wood preservatives used to prevent the growth of staining fungi in freshly cut lumber. They are applied to freshly-cut wood by dipping or spraying to achieve short-term (months) protection against staining fungi.

## Health Considerations

### Can Approved Uses of TCMTB Affect Human Health?

**Antisapstain products containing TCMTB are unlikely to affect your health when used according to revised label directions.**

Potential exposure to TCMTB may occur through the dermal and inhalation routes, when handling and applying antisapstain products containing TCMTB or by handling the treated wood. When assessing health risks, two key factors are considered: the levels at which no health effects occur in animal testing and the levels to which people may be exposed. The dose levels used to assess risks are established to protect the most sensitive human population (for example, children and nursing mothers). Only uses for which exposure is well below levels that cause no effects in animal testing are considered acceptable for continued registration.

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3 "Value" as defined by subsection 2(1) of the *Pest Control Products Act*: "... the product's actual or potential contribution to pest management, taking into account its conditions or proposed conditions of registration, and includes the product's (*a*) efficacy; (*b*) effect on host organisms in connection with which it is intended to be used; and (*c*) health, safety and environmental benefits and social and economic impact".

Toxicology studies in laboratory animals describe potential health effects from varying levels of exposure to a chemical and identify the dose where no effects are observed. The health effects noted in animals occur at doses more than 100-times higher (and often much higher) than levels to which humans are normally exposed when pesticide-containing products are used according to label directions.

In laboratory animals, TCMTB was of moderate acute oral toxicity, low acute dermal toxicity and high acute toxicity by the inhalation route of exposure. It was extremely irritating to the skin, and caused an allergic skin reaction. A waiver request was accepted for the acute eye irritation study based on the irritating effect of the test substance on skin.

Registrant-supplied, short- and long-term (lifetime) animal toxicity tests, as well as information from the published scientific literature were assessed for the potential of TCMTB to cause neurotoxicity, immunotoxicity, chronic toxicity, cancer, reproductive and developmental toxicity, and various other effects. TCMTB did not elicit any specific target organ toxicity in short- or long-term studies. The most sensitive endpoints for risk assessment included decreased body weight and weight gain and clinical signs of toxicity. The risk assessment protects against the above-noted effects by ensuring that the level of human exposure is well below the lowest dose at which these effects occur in animal tests.

**Risks in Residential and Other Non-Occupational Environments**

**Non-occupational risks are not of concern.**

There are currently no registered residential uses of TCMTB antisapstain products. As such, a risk assessment for a residential handler was not required.

**Occupational Risks to Mixer/Loader/Applicator and Postapplication Workers**

**Occupational risks are not of concern when used according to the revised label directions.**

Health risks to handlers are not of concern for all scenarios. Based on the updated personal protective equipment required as a result of the ERP for Antisapstain Chemicals (see section 3.4.3 of the science evaluation), health risk estimates associated with mixing, loading, and applying and during handling of treated wood exceeded target dermal margins of exposure (MOEs) and are not of concern. Inhalation exposure was shown to be very low for the majority of workers and is mitigated by the use of a NIOSH-respirator for specific job tasks where there is potential for inhalation exposure, as described in the ERP. Current product labels that do not include all of the required elements of the personal protective equipment will be updated to conform to the ERP.

**Postapplication risks are not of concern.**

Postapplication exposure through contact with dried wood is not anticipated as antisapstains are designed to prevent the growth of staining fungi in freshly cut lumber during storage and transit and not for long-term wood protection in residential or commercial areas. Similarly, exposure to consumers from contact with treated wood is also considered to be minimal.

No health risks of concern were identified for workers handling freshly treated wood (wet or dry) in the sawmill. Since this type of exposure is expected to be greater than for workers or bystanders handling treated wood after it has left the sawmill, postapplication health risks are not of concern.

## Environmental Considerations

### What Happens When TCMTB Is Introduced Into the Environment?

**When used as an antisapstain according to the revised label directions, TCMTB is not expected to pose risks of concern to the environment.**

Antisapstains, such as TCMTB, may enter the environment when newly treated wood is exposed to rain. Exposure to land organisms and their habitats from wood treatment facilities is expected to be negligible. It may reach the aquatic environment if any rainwater containing the chemical is permitted to run off from the treatment facility and its wood storage areas into nearby waterbodies.

TCMTB mixes readily in water and can move moderately easily through some soils and only slightly in other soils. TCMTB does not break down in the presence of water at low pHs but at high pHs, TCMTB breaks down quickly. TCMTB also breaks down quickly in the presence of light and in the presence of microbes. As a result of TCMTB's tendency to break down quickly in water and soils, it is not likely to contaminate groundwater. TCMTB is not expected to be found in air or to accumulate in the tissues of organisms. TCMTB's transformation products are less toxic than the parent.

TCMTB is highly toxic to aquatic organisms. However, when used according to the revised label directions, TCMTB and its transformation products are not expected to pose risks of concern to freshwater organisms (invertebrates, algae, vascular plants, fish and amphibians) or to marine invertebrates and fish.

## Value Considerations

### What is the Value of TCMTB in Antisapstain Treatment?

TCMTB is one of several active ingredients currently registered in Canada for use in antisapstain products. Antisapstain products are wood preservatives used to prevent the growth of staining fungi in freshly cut lumber. These pigmented fungi consume the readily available sugars and starches as they grow throughout the sapwood. While these sapstain fungi do not reduce the strength of the wood, the aesthetic damage done can result in significant economic losses in terms of the lumber being unmarketable or reduced in value.

## Proposed Measures to Minimize Risk

Labels of registered pesticide products include specific instructions for use. Directions include risk-reduction measures to protect human health and the environment. Following these directions is required by law. As a result of the re-evaluation of the antisapstain use of TCMTB, the PMRA

is proposing further risk-reduction measures in addition to those already identified on TCMTB product labels.

## Additional Key Risk Reduction Measures

### Human Health

To protect workers, additional general hygiene statements and personal protective equipment are required on all TCMTB antisapstain product labels conforming to the ERP.

### Environment

In order to minimize the amount of TCMTB entering aquatic environments, wood treatment facilities for antisapstains are to be equipped with drip pads (where wood is allowed to sit for a short drying period immediately after treatment) that are roofed and paved.

Precautionary label statements are required to identify environmental hazards and prevent runoff from treatment facilities to waterbodies.

## Next Steps

Before making a final re-evaluation decision on the antisapstain use of TCMTB, the PMRA will consider any comments received from the public in response to this consultation document. A science-based approach will be applied in making a final decision on TCMTB. The PMRA will then publish a Re-evaluation Decision[4] that will include the decision, the reasons for it, a summary of comments received on the proposed decision and the PMRA response to these comments.

[4] "Decision statement" as required by subsection 28(5) of the *Pest Control Products Act*.

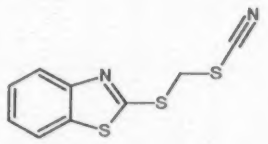
# Science Evaluation

## 1.0 Introduction

In addition to its use as an antisapstain, TCMTB is registered as a material preservative and a bioicide. There is no joinery use registered for this active ingredient.

## 2.0 The Technical Grade Active Ingredient, Its Properties and Uses

### 2.1 Identity of the Technical Grade Active Ingredient

| | | |
|---|---|---|
| **Common name** | | 2-(thiocyanomethylthio) benzothiazole |
| **Function** | | Antisapstain |
| **Chemical Family** | | Benzothiazole |
| **Chemical name** | | |
| | **1 International Union of Pure and Applied Chemistry (IUPAC)** | (1,3-benzothiazol-2-ylthio)methyl thiocyanate<br>or<br>2-(thiocyanatomethylthio)-1,3-benzothiazole |
| | **2 Chemical Abstracts Service (CAS)** | (2-benzothiazolylthio)methyl thiocyanate |
| **CAS Registry Number** | | 21564-17-0 |
| **Molecular Formula** | | $C_9H_6N_2S_3$ |
| **Structural Formula** | |  |
| **Molecular Weight** | | 238.4 |
| **Purity of the Technical Grade Active Ingredient** | | 80% |
| **Registration Number** | | 18448 |

### 2.2 Physical and Chemical Properties of the Technical Grade Active Ingredient

Complete data for the physical chemical properties of the technical grade active ingredient are not available. However, the physical and chemical properties of the technical grade active ingredient will be assessed when the additional chemistry data requirements have been provided. Additional data requirements include analytical data from five recent batches of the technical grade active ingredient to adequately identify any impurities of concern as well as updated specifications to reflect current manufacturing practices and any impurities of concern.

| Property | Result |
|---|---|
| Vapour pressure | 1.93 hPa (20°C)<br>2.29 hPa (25°C) |
| Ultraviolet (UV) / visible spectrum | Not available |
| Solubility in water | 45 mg/L |
| n-Octanol/water partition coefficient | log $K_{ow}$ = 1.40 |
| Dissociation constant | Not available |

No TSMP-implicated substances were identified at this time. However, the impurity profile of the technical grade active ingredient will be re-assessed when the additional data requirements for chemistry data have been provided by the registrant.

### 2.3 Description of Registered TCMTB Uses

Appendix I lists the antisapstain products containing TCMTB that are registered under the authority of the *Pest Control Products Act*.

An antisapstain product is applied to freshly-cut wood by dipping or spraying to achieve short-term protection against staining fungi. TCMTB has been shown to be effective in preventing sapstain on freshly treated lumber for a period of 2–6 months.

## 3.0 Impact on Human and Animal Health

### 3.1 Toxicology Summary

Following oral administration, TCMTB was rapidly absorbed in rats, with the urine as the primary route of excretion. TCMTB had limited bioaccumulation potential with a half-life of seven days, and the highest levels were found in red blood cells. TCMTB was rapidly metabolized to two metabolites. Total tissue residues were generally low indicating little deposition of the test material.

TCMTB is of moderate acute toxicity by the oral route in rats and of low acute dermal toxicity in rabbits. It is highly acutely toxic by the inhalation route in rats, extremely irritating to the skin of rabbits, and was a dermal sensitizer in guinea pigs. A waiver request was accepted for the acute eye irritation study based on the irritating effect of the test substance on skin.

TCMTB did not elicit any specific target organ toxicity in sub-chronic or long-term studies. The primary effects reflect the highly irritating nature of this chemical and included decreased body weight gain, effects on the non-glandular stomach or duodenal mucosa and clinical signs of toxicity including diarrhea, piloerection and hunched gait. Dogs appeared to be more sensitive to TCMTB than other test species, with deceased body weight gain at doses ≥11 mg/kg bw/day. There was no developmental toxicity noted in rabbits, and in the rat, no adverse effects were noted in the fetuses, while the dams showed clinical signs of toxicity. In the reproduction study there was a transient decrease in pup body weight on day 21 of lactation, which occurred in the absence of maternal toxicity, and was likely due to increased compound intake via both feed and milk. No treatment-related adverse effects were noted on parental and reproductive parameters and there was no evidence of sensitivity of the young.

In a 21-day dermal toxicity study in rats there was decreased body weight, body weight gain, body fat, food consumption, and biochemical and hematological changes at doses ≥100 mg/kg bw/day. No dermal NOAEL could be established in this study as irritation occurred at all dose levels, and was severe at ≥100 mg/kg bw/day.

TCMTB was not carcinogenic in the mouse oncogenicity study and was non-genotoxic in the in vitro and in vivo mutagenicity studies. There was an increase in thyroid C-cell adenomas in high-dose female rats, but there was no progression to carcinoma and no effect on survival. Increased hyperplasia of the duodenal mucosa and decreased body-weight gain were noted in mice, while parakeratosis of the non-glandular stomach was noted in rats. There was no evidence of malformations or effects on reproductive parameters with TCMTB, nor was there any evidence of increased susceptibility of the young.

### 3.1.1 *Pest Control Products Act* Hazard Characterization

For assessing risks from potential residues in food or from products used in and around homes or schools, the *Pest Control Products Act* requires the application of an additional 10-fold factor to threshold effects to take into account completeness of the data with respect to the exposure of and toxicity to infants and children, and potential prenatal and postnatal toxicity. A different factor may be determined to be appropriate on the basis of reliable scientific data.

With respect to the completeness of the toxicity database as it pertains to the toxicity to infants and children, the database for TCMTB contains a 2-generation reproductive toxicity study in rats and developmental toxicity studies in rats and rabbits.

With respect to potential prenatal and postnatal toxicity, in the 2-generation reproduction study, a transient decrease in pup body weight occurred on day 21 of lactation in the absence of maternal toxicity. This effect was likely due to increased compound intake via both feed and milk. No treatment-related adverse effects were noted on parental and reproductive parameters.

No developmental toxicity was noted in the rabbits, and in the rats. No adverse effects were noted in the fetuses, while the dams showed clinical signs of toxicity. Overall, there was no evidence of sensitivity of the young or serious endpoints of concern, therefore, the *Pest Control Products Act* factor was reduced to 1-fold.

### 3.2 Determination of Acceptable Daily Intake

Not applicable for antisapstain use.

### 3.3 Determination of Acute Reference Dose

Not applicable for antisapstain use.

### 3.4 Occupational and Non-Occupational Exposure and Risk Assessment

Occupational and non-occupational risk is estimated by comparing potential exposures with the most relevant endpoint from toxicology studies to calculate a margin of exposure (MOE). This is compared to a target MOE incorporating uncertainty factors protective of the most sensitive sub-population. If the calculated MOE is less than the target MOE, it does not necessarily mean that exposure will result in adverse effects, but mitigation measures to reduce risk would be required.

#### 3.4.1 Toxicological Endpoint Selection for Occupational Risk Assessment

Occupational exposure to TCMTB is characterized as intermittent long-term in duration and is predominately by the dermal route.

**For long-term dermal:**

For long-term dermal exposure, the no observed adverse effects level (NOAEL) of 25 mg/kg bw/day from the 21-day dermal study in rats was selected for use in risk assessment, based on decreased body weight, body weight gain, body fat, food consumption, and changes in biochemical and hematological parameters. This study also represents the relevant route of exposure. The target MOE is 300, which includes uncertainty factors of 10-fold for interspecies extrapolation and 10-fold for intraspecies variability, as well as a 3-fold factor to extrapolate from a short-term to a long-term exposure scenario, considering the evidence for increased toxicity with prolonged duration of exposure in the toxicity database. As noted in the *Pest Control Products Act* Hazard Characterization section, there are no concerns relevant to the worker population that would require the application of an additional factor. Therefore, the *Pest Control Products Act* factor was reduced to 1-fold.

**Table 3.4.1 Toxicology Endpoints for Use in Health Risk Assessment for TCMTB**

| Exposure Scenario | Study | Point of Departure and Endpoint | Target MOE |
|---|---|---|---|
| Long-term dermal | 21-day dermal toxicity study in rats | NOAEL for systemic toxicity = 25 mg/kg bw/day based on decreased body weight, body weight gain, body fat, food consumption, and biochemical and hematological changes (skin irritation) | 300[1] |
| Cancer | A cancer assessment is not required | | |

[1] Includes a 3-fold factor to extrapolate from a short-term to a long-term exposure scenario.

### 3.4.2 Dermal Absorption

There is no dermal absorption data on file for TCMTB. However, since a dermal endpoint is used for risk assessment, a dermal absorption value is not required.

### 3.4.3 Occupational Exposure and Risk Assessment

Workers can be exposed to the antisapstain chemical TCMTB while treating wood, handling treated wood and during clean-up, maintenance and repair activities.

The Sapstain Industry Group conducted passive dosimetry worker exposure studies to measure the potential exposure of sawmill workers that are exposed to antisapstain chemicals. The complete study was divided into four phases: Phase I identified an appropriate surrogate chemical; Phase II monitored workers to determine job tasks with a potential for exposure to antisapstain chemicals (handling wet treated lumber, handling dry treated lumber, maintenance (including clean-up) and operating diptanks); Phase III measured workers exposure to those job tasks; and Phase IV measured worker's exposure following the implementation of a Product Stewardship and Exposure Reduction Program (ERP) for the job tasks that demonstrated the highest exposure during Phase III. The workers with the highest potential for exposure included clean-up and maintenance workers, and pilers handling freshly treated wood. The ERP also identified areas in sawmills that would benefit from additional mitigation measures to reduce antisapstain chemical exposure, including engineering controls for application systems, instruction on safe handling procedures and proper personal protective equipment, and education on the health and safety properties of the antisapstain chemicals. The ERP was shown to reduce exposure for workers handling antisapstain chemicals.

#### 3.4.3.1 Occupational Antisapstain Exposure and Risk Assessment

As noted above, workers can be exposed to TCMTB while treating wood, handling treated wood and during clean-up, maintenance and repair activities. Exposure is expected to be long-term in duration and to occur primarily via the dermal route. Inhalation exposure was demonstrated to be very low for the majority of worker activities in the Phase III of the Sapstain Industry Group study and was not assessed during Phase IV. In addition, a NIOSH-respirator is required during

clean-up, maintenance and repairs, or if working in areas that are not well ventilated, in order to reduce potential inhalation exposure, as defined in the ERP.

Dermal exposure was estimated by combining the unit exposure values from the surrogate antisapstain worker exposure study with the amount of product handled per day and the dermal absorption value. Exposure was normalized to mg/kg bw/day by using 80 kg adult body weight.

The results of the health risk assessment for sawmill workers exposed to antisapstain products containing TCMTB are shown in Table 3.4.3.1. Calculated MOEs exceeded the target MOE and no health risks of concern were identified for sawmill workers wearing the appropriate personal protective equipment as outlined in Appendix III.

**Table 3.4.3.1 TCMTB Exposure Assessment for Sawmill Workers Exposed to Antisapstain Products**

| Tasks | Unit Exposure (µg/mg/mL) | Max Rate [1] (mg/mL) | Daily Exposure (mg/kg bw/day) | MOE [2] |
|---|---|---|---|---|
| SIG Phase IV | | | | |
| Pilers | 493.7 | 12.5 | 0.07714 | 324 |
| Clean-up Crew | 203.1 | 12.5 | 0.03173 | 788 |
| Maintenance Workers | 401.4 | 12.5 | 0.06272 | 399 |

TSC = Treatment solution concentration, MOE = Margin of exposure

[1] The maximum treatment solution rates of all TCMTB products is shown as the most conservative scenario.

[2] Dermal MOEs are based on a NOAEL of 25 mg/kg bw/day. Target MOE is 300. MOE = NOAEL/ (Unit Exposure (µg/kg a.i.) * Application Rate / Body Weight (80 kg)).

### 3.4.4 Postapplication Worker Exposure and Risk Assessment

Postapplication exposure (for wood that has left the sawmill) is not anticipated, as antisapstains are designed to prevent the growth of staining fungi in freshly cut lumber during storage and transit and not for long-term wood protection in residential or commercial areas.

Furthermore, no health risks of concern were identified for workers handling freshly treated wood (wet or dry) in the sawmill whose exposure is expected to be greater than for workers handling of treated wood after it has left the sawmill.

### 3.4.5 Non-Occupational Exposure and Risk Assessment

Non-occupational or residential risk assessment involves estimating risks to the general population, including children and youths, during or after pesticide application. There are no registered domestic class antisapstain products containing TCMTB. Residential exposure to individuals contacting wood treated with TCMTB for antisapstain is not expected to result in health risks of concern.

### 3.4.6 Bystander Exposure

Bystander exposure is not anticipated, as antisapstain products containing TCMTB are designed to prevent the growth of staining fungi in freshly cut lumber during storage and transit and not for long-term wood protection in residential or commercial areas.

Furthermore, no health risks of concern were identified for workers handling freshly treated wood (wet or dry) in the sawmill whose exposure is expected to be greater than for bystanders handling treated wood after it has left the sawmill.

Therefore, health risks to bystanders are not of concern.

### 3.5 Incident Reports Related to Health

As of October 27, 2016, no health related incident reports involving the active ingredient TCMTB were reported to the PMRA.

### 3.6 Cumulative Assessment

Cumulative assessment takes into consideration non-occupational exposures (exposure via dietary, drinking water and residential use) to multiple pesticides that share a common mechanism of toxicity. As there are no domestic class registrations for TCMTB as an antisapstain, a cumulative assessment is not required for this use.

## 4.0 Impact on the Environment

### 4.1 Fate and Behaviour in the Environment

Through its use as an antisapstain, TCMTB may enter the environment when it leaches from treated wood that has come in contact with water. Hydrolysis of TCMTB is pH dependent. At acidic pHs, TCMTB is stable to hydrolysis and it degrades very slowly at neutral pH. Under alkaline conditions, TCMTB degrades rapidly. TCMTB also phototransforms rapidly on soil and in water. TCMTB is non-persistent in aerobic soil as well as in both aerobic and anaerobic water/sediment systems. TCMTB is soluble in water and ranges from moderately mobile to slightly mobile in soil. Based on TCMTB's tendency to break down quickly in water and soils, TCMTB is unlikely to move downward through soil to groundwater. Several transformation products are formed during the abiotic and biotic degradation of TCMTB, including benzothiozole sulfonic acid (BTSA), 2,2-dithiobisbenzo-thiazole (DBB), and 2-mercaptobenzo-thiazole (MBT). BTSA is not of toxicological concern since its toxicity is negligible and it is completely excreted. The transformation products DBB and MBT are less toxic than the parent and therefore only TCMTB was considered in the risk assessment.

Volatilization and subsequent phototransformation of TCMTB in air is unlikely due to the low vapour pressure. Bioaccumulation of TCMTB is not expected to be a concern in animal tissues or the environment as it depurates from tissues rapidly.

Information regarding the physicochemical properties of TCMTB is presented in Appendix II, Table 1. Data on the fate and behaviour of TCMTB in the environment are presented in Appendix II, Table 2.

### 4.2 Environmental Risk Characterization

The environmental risk assessment integrates the environmental exposure and ecotoxicology information to estimate the potential for adverse effects on non-target species. This integration is achieved by comparing exposure concentrations with concentrations at which adverse effects occur. Estimated environmental concentrations (EECs) are concentrations of pesticide in various environmental media, such as food, water, soil and air. The EECs are estimated using standard models which take into consideration the application rate(s), chemical properties and environmental fate properties, including the dissipation of the pesticide in the environment.

Environmental exposure from chemicals used to treat wood may result from two scenarios: runoff from wood treatment facilities to adjacent waterbodies and direct leaching from wood in-use to water or soil. Antisapstain products are designed for short-term protection of wood, primarily during its storage and transit. The treated wood is not expected to be in direct contact with soil or water during its use, such as in the construction of above-ground components of various structures. Therefore, only an assessment of the potential environmental exposure from treatment facilities was considered to be relevant for antisapstain products.

At wood treatment facilities using antisapstain products, these chemicals may enter the environment when freshly treated wood is exposed to precipitation (primarily rainwater). Although the wood treatment process itself generally occurs in enclosed areas, immediately after the treatment the wood needs to sit for a short period of time to allow excess treatment solution to drip off the freshly-treated wood and for the wood to dry. This initial drying process is to take place outside on a drip pad that is roofed and paved. This minimizes the exposure of the treated wood to rain, while the paved surface aids in containing the drippings from the wood and channeling any excess chemicals to the appropriate receptacles for recycling or disposal. However, once the treated wood is dry, it is stored at the treatment facility until shipment to retailers and may be exposed to rain. Therefore, there is a potential that when used as an antisapstain, TCMTB may enter the environment through leaching from the treated wood during storage at wood treatment facilities.

Exposure of terrestrial organisms to TCMTB within the vicinity of these storage areas is expected to be negligible. Therefore, the risk to terrestrial organisms was not considered further in the risk assessment. Exposure to aquatic habitats is possible if TCMTB leaches from stored, treated wood at treatment facilities and runs-off to adjacent waterbodies.

The EECs of TCMTB resulting from this use are based on selected exposure scenarios (Appendix II, Table 3), developed from the OECD Revised Emission Scenario Document for Wood Preservatives. Scenario selection was based on the following considerations:

- TCMTB is to be applied only by dipping (including immersion) or automated spraying (large plant / small plant) at treatment facilities.

- As TCMTB is not expected to volatilize, EECs in air are expected to be negligible. EECs for this compartment are not required.
- Exposure of non-target organisms in the terrestrial environment is expected to be minimal.
- Environmental exposure to these products when the wood is in use is expected to be limited.
- Treatment facilities, including the drip pad for initial drying of treated wood, consist mostly of paved and roofed areas, except for longer-term storage, so leaching of TCMTB from treated wood to soil is expected to be limited to in and around the facilities.
- TCMTB may enter the aquatic environment through leaching from treated wood stored at treatment facilities followed by run-off to nearby waterbodies (either freshwater or marine).

### 4.2.1 Risks to Aquatic Organisms

The exposure scenario for freshwater and estuarine organisms considers surface runoff into adjacent waterbodies from treatment plants using automated spraying (small plant, scenario 1; large plant, scenario 2) and dipping (scenario 3) product application methods. Conservative scenarios were used in the assessment. Specifically, it was assumed that the storage areas were uncovered and unprotected, 100% of the pesticide leached during the storage period, and that 50% of the rainwater ran directly into an adjacent surface water body. Further details for all exposure scenarios are presented in Appendix II, Table 3.

For the OECD scenarios, EECs are derived from the specific scenario parameters identified in Appendix II, Table 3 in combination with the deposition rate of the chemical as stated on the label (Appendix II, Table 4). For each scenario, EECs are representative of a daily average taken over the course of the storage period and consider that 100% of the pesticide leaches during that time.

Ecotoxicology information includes acute and chronic toxicity data for freshwater fish and invertebrates, as well as acute toxicity data for freshwater algae, freshwater vascular plants, marine fish, and marine invertebrates. A summary of the available aquatic toxicity data for TCMTB is presented in Appendix II, Table 5. Aquatic toxicity values used for this assessment are summarized in Appendix II, Tables 6, 7, and 8.

For characterizing acute risk, acute toxicity values ($LC_{50}$, $LD_{50}$, and $EC_{50}$) are multiplied by an uncertainty factor. The uncertainty factor is used to account for differences in inter- and intra-species sensitivity as well as varying protection goals (community, population, individual). Thus, the magnitude of the uncertainty factor depends on the group of organisms that are being evaluated (0.1 for fish, 0.5 for aquatic invertebrates). When assessing chronic risk, the NOEC or NOEL is used and an uncertainty factor is not applied.

A risk quotient (RQ) is calculated by dividing the exposure estimate by an appropriate toxicity value (RQ = exposure/toxicity), and the RQ is then compared to the level of concern (LOC). If the screening level RQ is below the LOC (LOC=1 for aquatic organisms), the risk is considered negligible and no further risk characterization is necessary. If the screening level RQ is equal to or greater than the LOC, then further characterization of the risk is required. Data derived from

wood leaching studies may be used in refining a risk assessment. Calculated EECs and RQs for freshwater and marine organisms are located in Appendix II, Table 6.

**Freshwater Invertebrates:** The risk quotient values for acute toxicity to freshwater invertebrates did not exceed the LOC for surface runoff from either a small spray treatment facility or a dip treatment facility. The risk quotient value did, however, exceed the LOC when considering acute exposure to runoff from a large spray treatment facility (RQ = 4.1). The risk quotient values for chronic toxicity to freshwater invertebrates exceeded the LOC for surface runoff from all three scenarios (highest RQ = 50.2 from a large spray treatment facility).

**Freshwater Fish and Amphibians:** The risk quotient values for acute and chronic toxicity to freshwater fish exceeded the LOC for surface runoff from all scenarios (highest acute RQ = 51.4, highest chronic RQ = 131.5, both from large spray treatment facilities) The acute and chronic risks to the aquatic life stages of amphibians were assessed based on the generic freshwater environment scenarios, using the most sensitive fish toxicity values as surrogate endpoints (in other words, based on the bluegill sunfish acute toxicity study and the rainbow trout chronic toxicity study). The risk quotient values for acute and chronic exposure of amphibians to TCMTB exceeded the LOC (acute RQ = 51.4, chronic RQ = 131.5) when considering acute exposure to runoff from a large treatment facility.

**Freshwater Algae:** The risk quotient values for acute toxicity to freshwater algae did not exceed the LOC for surface runoff from any scenario. TCMTB is not expected to pose a risk to freshwater algae.

**Freshwater Vascular Plants:** The risk quotient values for acute toxicity to freshwater vascular plants did not exceed the LOC for surface runoff from any scenario. TCMTB is not expected to pose a risk to freshwater vascular plants.

**Marine Invertebrates:** The risk quotient value for acute toxicity to marine invertebrates did not exceed the LOC for surface runoff from a small spray treatment facility. The risk quotient values did, however, exceed the LOC when considering acute exposure to runoff from a large spray treatment facility (RQ = 6.4) or a dip treatment facility (RQ= 1.2).

**Marine Fish:** The risk quotient values for acute toxicity to marine fish did not exceed the LOC for surface runoff from either a small spray treatment facility or a dip treatment facility. The risk quotient value did, however, slightly exceed the LOC when considering acute exposure to runoff from a large spray treatment facility (RQ = 1.5).

Risk quotients for effects of runoff to freshwater and marine organisms (invertebrates and fish) range from 4.1 to 131.5 and 1.2 to 6.4, respectively, and are based on several conservative assumptions. The estimated exposure considers that allof the active ingredient present in/on stored lumber leaches out of the wood within a relatively short storage period and that 50% of the pesticide leached will reach the aquatic environment following an average rain pattern. To further characterize the acute and chronic risk to freshwater invertebrates, fish and amphibians, as well as acute risk to marine invertebrates and fish, available wood leaching data were examined.

Leaching From Rough Cut and Planed Lumber

A study was conducted to assess, under operational conditions, the leaching of TCMTB from surface-treated lumber exposed to the rain in a sawmill yard. A sawmill in British Columbia, Canada, which uses state-of-the-art high pressure spray box systems was selected for the study. The seven hectare site was comprised of a sawmill and a segregated rough cut and finished lumber storage yard. The drainage from each yard was segregated and discharged directly to the foreshore of the Fraser River. The product containing TCMTB was applied to rough cut and planed spruce-pine-fir lumber at the rate of 610 000 ± 200 000 µg a.i./$m^2$. This rate was 30 % higher than the label recommended rate of 400 000 µg a.i./$m^2$. Treated lumber was stored in covered bins for up to 10 hours prior to stacking the packages in an asphalt-paved yard. Five types of samples, consisting of rainwater, working solution, leachate, runoff and river water, were collected. Samples were analysed for TCMTB and three of its transformation products.

It was reported that in treated lumber with less than one hour of covered storage, the average concentration in the leachate was 89 mg a.i./L. This is much higher than the concentration in the leachate from packaged lumber. During this period the average concentration in the runoff to the storm sewer was 7.5 mg a.i./L. In treated lumber with at least 12 hours of covered storage, the average concentration in the leachate from the lumber was 5.43 mg a.i./L. The average concentration in the runoff to the storm sewer was 0.34 mg a.i./L.

It is expected that the runoff to the storm sewer will be further diluted by the receiving environment (for example, a marine estuary or river). In previous scientific evaluations by Health Canada in order to account for the expected dilution, a generic dilution factor of 10 was applied to the concentrations. The generic dilution factor of 10 is affected by many variables including volume, flow rates and mixing characteristics of the receiving water body. Risk quotient values were calculated using all toxicity endpoints in combination with the average concentration of TCMTB from lumber with at least 12 hours of covered storage, with the 10 fold dilution factor applied to account for further dilution in the receiving environment (Appendix II, Table 7). Using these values, calculated concentrations of TCMTB found in runoff from treatment facilities to water bodies exceeded the level of concern for acute and chronic risk to freshwater invertebrates, acute and chronic risk to freshwater fish and amphibians, as well as acute risk to marine invertebrates and fish (highest RQ = 100 for chronic risk to freshwater fish and amphibians).

Leaching from Packaged Lumber

A study was conducted to assess the leaching of TCMTB from packaged lumber treated with Busan 1030W and exposed to rain in a sawmill yard. Packages of rough cut spruce-pine-fir were dipped for 30 seconds in the dip tank containing 0.11 % (w/w) TCMTB and piled no more than four packages high in a covered storage area for an overnight period to allow excess treating solution to drain. Each package contained 54 to 128 pieces of lumber of various specified dimensions. After the holding period, the packages were placed individually in the yard, in an area where they would be fully exposed to rain and remain undisturbed. Ten samples of wood were taken from the outside of each package after being placed in the yard, before exposure to rain, and analysed for TCMTB. During periods of rain, samples of leachate were collected in polyethylene jars placed underneath the package, where the leachate dripped from the packages.

Precipitation was monitored over the 10 day duration of the test by collecting rainwater in three gauges placed between the lumber packages. The first leachate was collected during the first rainfall period, which began about 28 hours after the packages were placed in the yard, and consisted of rainfall over a seven hour period. A total of three separate rainfall events occurred during the 10 day period and the packages were exposed to a total of 42 mm of rain. Leachate was analysed by HPLC.

The study reported that the overall retention of TCMTB on the lumber after treatment and prior to rainfall was 250 000 µg a.i./$m^2$, which is approximately 40% lower than the label recommended rate of 400 000 µg a.i./$m^2$. The concentration of TCMTB in the leachate was reported to range from 0.57 mg a.i./L to 7.20 mg a.i./L, with significant variability between the lumber packages and sampling times. The average concentration of the leachate from all packages and sampling times was 2.97 mg a.i./L.

As this value represents an average concentration of leachate dripping directly from the wood, it is expected that it will be further diluted in runoff water and again upon entry into the receiving environment (for example, marine estuary or river). To account for these dilutions, a conservative dilution factor of 100 was applied to the average concentration of leachate dripping directly from the wood. The 100-fold dilution factor was derived by applying a 10-fold dilution factor to account for the dilution of the leachate in runoff from the yard, combined with an additional 10-fold dilution factor to account for the expected dilution once the runoff reaches the receiving environment. Risk quotient values were calculated using all toxicity endpoints in combination with the average measured concentration of TCMTB with the 100-fold dilution factor applied (Appendix II, Table 8). Using these values, concentrations of TCMTB leaching from wood at treatment facilities and eventually running off to waterbodies exceeded the level of concern for acute and chronic risk to freshwater invertebrates, acute and chronic risk to freshwater fish and amphibians, as well as acute risk to marine invertebrates (highest RQ = 87.4 for chronic risk to freshwater fish and amphibians).

The results from both studies examining leaching of TCMTB from wood at treatment facilities yield slightly lower RQ values than the results found using the OECD scenarios, although they are all similar in magnitude (highest RQ = 131 in large plant OECD scenario, highest RQs = 100 and 87 in the two wood leaching studies; Tables 6, 7, and 8, respectively). These results indicate a potential for acute and chronic risk to freshwater invertebrates, acute and chronic risk to freshwater fish and amphibians, as well as acute risk to marine invertebrates and fish.

TCMTB is likely to breakdown relatively quickly in the environment, which could mitigate the potential for chronic risk to some organisms. Acute aquatic risk through entry of TCMTB is, however, still a concern. Mitigation measures to reduce or prevent runoff of TCMTB from wood treatment facilities to aquatic habitats are necessary. This will include protecting treated wood from contact with rain or standing water during drying and storage. The registered label for antisapstain uses of TCMTB currently indicates precautions and storage instructions to protect treated wood from rain washing or coming in contact with water. Additional precautionary statements will be required and are indicated in Appendix III.

When the mitigation measures aimed to reduce the ability of TCMTB to run-off from treatment facilities to aquatic habitats are followed, the use of TCMTB antisapstain is not expected to pose a risk of concern to the environment.

### 4.2.2 Overall Summary

When used as an antisapstain according to the revised label directions, TCMTB is not expected to pose risks of concern to the environment. TCMTB has the potential to leach from wood at treatment facilities and subsequently run-off to aquatic environments. Mitigation measures include directions to prevent surface runoff water from wood freshly treated with TCMTB from reaching aquatic systems as well as the use of precautionary label statements identifying environmental hazards on the product labels. (Appendix III)

### 4.2.3 Incident Reports Related to the Environment

As of October 27, 2016, no incident reports involving TCMTB have been submitted to the PMRA.

## 5.0 Value

TCMTB has value as one of several antisapstain active ingredients for controlling sapstain. The current active ingredients have replaced older antisapstain chemistries based on chlorophenates, which were phased-out in the 1980's for this use due to health and environmental concerns.

The application rates of antisapstain products are expressed both as treatment solution concentrations (%) and as the deposition rate in the treated wood (for example, µg a.i. per $cm^2$ wood). They are applied to freshly-cut wood in saw mills by dipping or spraying to achieve a short-term protection of several months. An alternative to antisapstain treatment is kiln-drying of the wood. However, some freshly cut lumber may still require antisapstain treatment while it is stored prior to kiln drying.

## 6.0 Pest Control Product Policy Considerations

### 6.1 Toxic Substances Management Policy Considerations

The Toxic Substances Management Policy (TSMP) is a federal government policy developed to provide direction on the management of substances of concern that are released into the environment. The TSMP calls for the virtual elimination of Track 1 substances [those that meet all four criteria outlined in the policy: persistent (in air, soil, water and/or sediment), bio-accumulative, primarily a result of human activity and toxic as defined by the *Canadian Environmental Protection Act, 1999*].

During the review process, TCMTB was assessed in accordance with the PMRA Regulatory Directive DIR99-03[5] and evaluated against the Track 1 criteria. The PMRA has reached the following conclusions:

- TCMTB does not meet TSMP Track 1 criteria, and is not considered a TSMP Track 1 substance. See Appendix I, Table 9 for comparison with Track 1 criteria.

### 6.2 Formulants and Contaminants of Health or Environmental Concern

During the review process, contaminants in the technical and formulants and contaminants in the end-use products are compared against the *List of Pest Control Product Formulants and Contaminants of Health or Environmental Concern* maintained in the *Canada Gazette*.[6] The list is used as described in the PMRA Notice of Intent NOI2005-01[7] and is based on existing policies and regulations including DIR99-03 and DIR2006-02[8] and taking into consideration the Ozone-depleting Substance Regulations, 1998, of the *Canadian Environmental Protection Act* (substances designated under the Montreal Protocol). The PMRA has reached the following conclusions:

- TCMTB does not contain any contaminants of health or environmental concern identified in the *Canada Gazette*.
- The end-use products Busan 30 Liquid Microbiocide Concentrate, Busan 1030 Liquid Microbiocide, and Busan 30L Liquid Microbiocide Concentrate do not contain any formulants or contaminants of health or environmental concern identified in the *Canada Gazette*.

The use of formulants in registered pest control products is assessed on an ongoing basis through PMRA formulant initiatives and Regulatory Directive DIR2006-02.

## 7.0 Proposed Re-evaluation Decision

The PMRA is proposing that the antisapstain use of products containing TCMTB are acceptable for continued registration with additional risk-reduction measures to protect human health and the environment. The proposed mitigation measures are presented in Appendix III. No additional data are being requested at this time.

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5 DIR99-03, *The Pest Management Regulatory Agency's Strategy for Implementing the Toxic Substances Management Policy*

6 *Canada Gazette*, Part II, Volume 139, Number 24, SI/2005-114 (2005-11-30) pages 2641–2643: *List of Pest Control Product Formulants and Contaminants of Health or Environmental Concern* and in the order amending this list in the *Canada Gazette*, Part II, Volume 142, Number 13, SI/2008-67 (2008-06-25) pages 1611-1613. *Part 1 Formulants of Health or Environmental Concern, Part 2 Formulants of Health or Environmental Concern that are Allergens Known to Cause Anaphylactic-Type Reactions and Part 3 Contaminants of Health or Environmental Concern.*

7 NOI2005-01, *List of Pest Control Product Formulants and Contaminants of Health or Environmental Concern under the New Pest Control Products Act.*

8 DIR2006-02, *Formulants Policy and Implementation Guidance Document.*

## List of Abbreviations

| | |
|---|---|
| a.i. | active ingredient |
| bw | body weight |
| CAS | Chemical Abstracts Service |
| CHO | Chinese hamster ovary |
| cm | centimetre(s) |
| d | day(s) |
| DACO | data code |
| DNA | deoxyribonucleic acid |
| DDAC | didecyldimethylammonium chloride |
| $DT_{50}$ | dissipation time 50% (the time required to observe a 50% decline in concentration) |
| DIR | Directive |
| $EC_{50}$ | effective concentration on 50% of the population |
| EEC | estimated environmental concentration |
| ERP | Exposure Reduction Program |
| EU | European Union |
| g | gram(s) |
| h | hectare(s) |
| HGPRT | hypoxanthine-guanine phosphoribosyltransferase |
| IUPAC | International Union of Pure and Applied Chemistry |
| kg | kilogram(s) |
| L | litre(s) |
| LOC | level of concern |
| $LC_{50}$ | lethal concentration to 50% |
| LD | lactation day |
| $LD_{50}$ | lethal dose to 50% |
| m | meter(s) |
| mg | milligram(s) |
| mL | millilitre |
| MOE | margin of exposure |
| N/A | not applicable |
| NIOSH | National Institute of Occupational Safety and Health |
| NOAEL | no observed adverse effect level |
| NOEC | no observed effect concentration |
| NOEL | no observed effect level |
| P | parental generation |
| ppb | parts per billion |
| PMRA | Pest Management Regulatory Agency |
| PPE | personal protective equipment |
| ppm | parts per million |
| PRVD | Proposed Re-evaluation Decision |
| RQ | risk quotient |
| RRD | Re-evaluation Decision |
| s | second(s) |

| | |
|---|---|
| SIG | Sapstain Industry Group |
| TCMTB | 2-(thiocyanomethylthio) benzothiazole |
| TGAI | technical grade active ingredient |
| TSC | treatment solution concentration |
| TSMP | Toxic Substances Management Policy |
| USEPA | United States Protection Agency |
| UV | ultraviolet |
| wt(s) | weight(s) |
| µg | microgram |
| µL | microlitre |

# Appendix I

## Table 1 Antisapstain TCMTB Products Currently Registered

| Active | Technical Grade Active Ingredient Sources | | End-Use Products | |
|---|---|---|---|---|
| | Registration Number | Product Name | Registration Number | Product Name |
| TCMTB | 18448 | TCMTB Liquid Microbiocide Concentrate | 14506 | Busan 30 Liquid Microbicide Concentrate |
| | | | 17990 | Busan 1030 Liquid Microbicide |
| | | | 18925 | Busan 30L Liquid Microbicide Concentrate |

# Appendix II

**Table 1 Summary of Physicochemical Properties of 2-(thiocyanomethylthio) benzothiazole (TCMTB)**

| Compound | Type of the study | Value | Comments |
|---|---|---|---|
| TCMTB | Solubility | 45 mg/L | Soluble (PMRA# 1163868) |
| TCMTB | Vapour Pressure | $3.57 \times 10^{-6}$ mmHg | Non-volatile (PMRA# 1214810) |
| TCMTB | Henry's Law Constant 1/H | $9.95 \times 10^{5}$ (calculated) | $25^{0}$C. H = $2.45 \times 10^{-8}$ atm $m^3$/mol. Non-volatile from water and moist soil |
| TCMTB | Octanol-Water Partition Coefficient, log $K_{OW}$ | 3.23 | Potential for bioaccumulation. (PMRA# 1163832) |
| TCMTB | UV absorption spectrum in aqueous buffered solution λ=190-400nm | $\lambda_{max}$ = 280 nm at pH 5 | TCMTB absorbs light at wavelengths below that of sunlight reaching the earth surface (that is, <290 nm); absorbance at wavelengths above 400 nm not determined. (PMRA# 1213858) |

**Table 2 Fate and Behaviour of TCMTB in the Environment**

| Property | Test substance | Value | Transformation products | Comments | Reference |
|---|---|---|---|---|---|
| **Abiotic transformation** | | | | | |
| Hydrolysis | [Cyano-$^{14}$C]-TCMTB | pH 9: $t_{1/2}$ = 1.8 d | Major: $CO_2$, ionized form of thiocyanate Minor: nonionized form of thiocyanate, unknown compounds | Rapid hydrolysis under alkaline conditions | PMRA# 1157797 |
| Hydrolysis | [benzene-R-UL-$^{14}$C]-TCMTB | pH 5: stable pH 7: slightly unstable pH 9: $t_{1/2}$ = 3.38 d | Major: 2,2-dithiobisbenzo-thiazole (DBB) Minor: unknown compounds | Hydrolysis is an important route of transformation under alkaline conditions | PMRA# 1213857 |
| Phototransfor-mation on soil | [Ring-UL-$^{14}$C]-TCMTB | $DT_{50}$ (irradiated): 6.3 d $DT_{50}$ (dark): 5.58 d | Major: Benzothiozole sulfonic acid (BTSA) Minor: unknown compounds | Phototransformation is an important route of transformation | PMRA# 1157798 |
| Phototransfor-mation in water | [U-ring-$^{14}$C]-TCMTB | $DT_{50}$ = 2.8 d | Major: 2-mercaptobenzo-thiazole (MBT), 2,2-dithiobisbenzo-thiazole (DBB), unknown compounds, Minor: unknown compounds | Phototransformation is an important route of transformation | PMRA# 1214183 |

| Property | Test substance | Value | Transformation products | Comments | Reference |
|---|---|---|---|---|---|
| **Biotransformation** | | | | | |
| Biotransformation in aerobic soil | [Ring-UL-$^{14}$C]-TCMTB | Sandy loam soil (76% sand, 17% silt, 7% clay, 1.4% OM, pH 6.9)<br>$DT_{50}$: < 2 d | Not reported | TCMTB transforms rapidly and is non-persistent in aerobic soil | PMRA# 1228601 |
| Biotransformation in aerobic water systems | [U-ring-$^{14}$C]-TCMTB | Pond water (pH 8 - 8.5) and sediment (1% OM, 96% sand, 3% silt, 1% clay, pH 7)<br>$DT_{50}$: 2.8 d (first order kinetics) | Major: MBT, DBB, unknown compound | TCMTB transforms rapidly and is non-persistent in aerobic aquatic systems | PMRA# 1213860 |
| Biotransformation in anaerobic water systems | [Ring-UL-$^{14}$C]-TCMTB | Pond water (pH 8.5) and sediment (0.8% OM, 92% sand, 6% silt, 2% clay, pH 7.8)<br>$DT_{50}$: 3.7 d (first order kinetics) | Not reported | TCMTB transforms rapidly and is non-persistent in anaerobic aquatic systems | PMRA# 1232759 |
| **Mobility** | | | | | |
| Adsorption ($K_d$) | [U-ring-$^{14}$C]-TCMTB | Four soils (sand, sandy loam, silt loam, clay loam)<br>$k_d$: 1.9 – 38.4 | Not reported | TCMTB ranges from moderately mobile to slightly mobile depending on soil type | PMRA# 1214812 |
| **Bioconcentration** | | | | | |
| 63-d flow-through bioconcentration study in Bluegill sunfish | $^{14}$C-TCMTB | Whole body BCF: 49 - 184<br>Time for 50% depuration modelled as 0.74 ± 0.073 days | Not reported | TCMTB is not expected to bioconcentrate in fish to a significant extent | PMRA# 1157800 |
| 28-d flow-through bioconcentration study in Bluegill sunfish | $^{14}$C-TCMTB | Whole body BCF: 230<br>Rapid elimination during the first three days of depuration period. Depuration half-life was attained within first three days of depuration period. | Not reported | TCMTB is not expected to bioconcentrate in fish to a significant extent | PMRA# 1228603 |

**Table 3 Scenarios Considered for the Risk Assessment**

| Scenario | Description | Details | |
|---|---|---|---|
| | **Scenario for industrial preventive treatment** | | |
| | ***Runoff from storage of treated wood*** | | |
| 1 | ***Automated spraying (small plant)*** | Surface area of the storage place: | 79 $m^2$ |
| | | Exposed surface of wood: | 11 $m^2/m^2$ |
| | | Duration of storage: | 3 d |
| | | Rain fraction reaching water: | 0.5 |
| | | Flow rate of creek/river: | 0.3 $m^3s^{-1}$ |
| 2 | ***Automated spraying (large plant)*** | Surface area of the storage place: | 790 $m^2$ |
| | | Exposed surface of wood: | 11 $m^2/m^2$ |
| | | Duration of storage: | 3 d |
| | | Rain fraction reaching water: | 0.5 |
| | | Flow rate of creek/river: | 0.3 $m^3s^{-1}$ |
| 3 | ***Dipping/Immersion*** | Surface area of the storage place: | 700 $m^2$ |
| | | Exposed surface of wood: | 11 $m^2/m^2$ |
| | | Duration of storage: | 14 d |
| | | Rain fraction reaching water: | 0.5 |
| | | Flow rate of creek/river: | 0.3 $m^3s^{-1}$ |

**Table 4 Amount of TCMTB Leached from Freshly Treated Wood**

| Scenario | Deposition rate (µg/$m^2$)[a] | Surface area of the storage place ($m^2$) | Exposed surface of wood ($m^2/m^2$) | Storage Period (d) | Amount of TCMTB leached (kg/d)[b,c] |
|---|---|---|---|---|---|
| Automated spraying (small plant) | 400 000 | 79 | 11 | 3 | 0.12 |
| Automated spraying (large plant) | 400 000 | 790 | 11 | 3 | 1.16 |
| Dipping/Immersion | 400 000 | 700 | 11 | 14 | 0.22 |

[a]Highest deposition rate of TCMTB from all antisapstain products currently registered by the PMRA and confirmed by VRD.
[b]Amount of TCMTB leached = Deposition rate * Surface area of the storage place * Exposed surface of wood / Storage period.
[c]Emissions from a storage facility are considered stable over time and assume that 100% of the pesticide leaches during the storage period.

**Table 5 Toxicity of TCMTB to Non-Target Aquatic Species**

| Organism | Exposure | Test substance | Endpoint value | Degree of toxicity[1] | Reference |
|---|---|---|---|---|---|
| **Freshwater species** | | | | | |
| *Daphnia magna* | 48h-Acute | TCMTB | $EC_{50}$ = 0.022 mg a.i./L | Very highly toxic | PMRA# 1239264 |
| *Daphnia magna* | 48h-Acute | Busan 30 | $EC_{50}$ = 0.06 mg a.i./L | Very highly toxic | PMRA# 1227860 |
| *Daphnia magna* | 21d-Chronic | TCMTB | NOEC= 0.00089 mg a.i./L | | PMRA# 1157769 |
| Rainbow trout, *Onchorhynchus mykiss* | 96h-Acute | TCMTB | $LC_{50}$ = 0.021 mg a.i./L | Very highly toxic | PMRA# 1227860 |
| Bluegill sunfish, *Lepomis macrochirus* | 96h-Acute | TCMTB | $LC_{50}$= 0.0087 mg a.i./L | Very highly toxic | PMRA# 1239263 |
| Zebra fish, *Brachydanio rerio* | 96h-Acute | Busan 30 | $LC_{50}$= 0.07 mg a.i./L | Very highly toxic | PMRA# 1227864 |

| Organism | Exposure | Test substance | Endpoint value | Degree of toxicity[1] | Reference |
|---|---|---|---|---|---|
| Rainbow trout, *Onchorhynchus mykiss* (early life-stage) | 60d-Chronic | TCMTB | NOEC= 0.00034 mg a.i./L, growth and egg hatchability | | PMRA# 1157771 |
| Green alga, *Selenastrum capricornutum* | 96h-Acute | Busan 30 | $EC_{50}$= 0.10 mg a.i./L growth rate | | PMRA# 1172133 |
| Duckweed, *Lemna minor* | 14d-Acute | TCMTB | $EC_{50}$= 0.28 mg a.i./L frond production<br>$EC_{50}$= 1.6 mg a.i./L growth rate<br>$EC_{50}$= 2.9 mg a.i./L frond mortality | | PMRA# 1170192 |
| *Daphnia magna* | 48h-Acute | 2-MBT | $EC_{50}$ = 2.900 mg a.i./L | Moderately toxic | Collins, M.K., 1992b in PMRA# 2661247 |
| Rainbow trout, *Onchorhynchus mykiss* | 96h-Acute | 2-MBT | $LC_{50}$= 0.730 mg a.i./L | Highly toxic | Collins, M.K., 1992 in PMRA# 2661247 |
| **Marine species** | | | | | |
| Mysid shrimp, *Mysidopsis bahia* | 96h-Acute | TCMTB | $LC_{50}$= 0.021 mg a.i./L | Very highly toxic | PMRA# 1214816 |
| Quahog clam, *Mercenaria mercenaria* (embryo-larvae) | 48h-Acute | TCMTB | $EC_{50}$= 0.014 mg a.i./L | Very highly toxic | PMRA# 1157768 |
| Sheepshead Minnow, *Cyprinodon variegatus* | 96h-Acute | TCMTB | $LC_{50}$= 0.060 mg a.i./L | Very highly toxic | PMRA# 1157801 |

[1] United States Environmental Protection Agency classification

**Table 6 Expected Environmental Concentrations (EECs) and Risk Quotients (RQs) for Freshwater and Marine Organisms Based on Storage of Treated Wood (Surface Runoff from Treatment Facilities).**

| Organism | Species Uncertainty Factor | Endpoint[1] | | | 1-d EEC[2] (mg a.i./L) | RQ[3] |
|---|---|---|---|---|---|---|
| ***Storage after automated spraying (small plant)*** | | | | | | |
| ***Freshwater organisms*** | | | | | | |
| *Daphnia magna* | 1/2 | 48-h $EC_{50}$ | = | 0.011 mg a.i./L | 0.0045 | 0.406 |
| *Daphnia magna* | 1 | 21-d NOEC | = | 0.00089 mg a.i./L | 0.0045 | **5.023** |
| Bluegill sunfish | 1/10 | 96-h $LC_{50}$ | = | 0.00087 mg a.i./L | 0.0045 | **5.138** |
| Rainbow trout | 1 | 60-d NOEC | = | 0.00034 mg a.i./L | 0.0045 | **13.148** |
| Green algae | 1/2 | 96-h $EC_{50}$ | = | 0.05 mg a.i./L | 0.0045 | 0.089 |
| Duckweed | 1/2 | 14-d $EC_{50}$ | = | 0.14 mg a.i./L | 0.0045 | 0.032 |
| ***Marine organism*** | | | | | | |
| Quahog Clam | 1/2 | 48-h $LC_{50}$ | = | 0.007 mg a.i./L | 0.0045 | 0.639 |
| Sheepshead minnow | 1/2 | 96-h $LC_{50}$ | = | 0.030 mg a.i./L | 0.0045 | 0.149 |

| Organism | Species Uncertainty Factor | Endpoint[1] | | | 1-d EEC[2] (mg a.i./L) | RQ[3] |
|---|---|---|---|---|---|---|
| ***Storage after automated spraying (large plant)*** | | | | | | |
| ***Freshwater organisms*** | | | | | | |
| *Daphnia magna* | 1/2 | 48-h $EC_{50}$ | = | 0.011 | mg a.i./L | 0.0447 | **4.064** |
| *Daphnia magna* | 1 | 21-d NOEC | = | 0.00089 | mg a.i./L | 0.0447 | **50.227** |
| Bluegill sunfish | 1/10 | 96-h $LC_{50}$ | = | 0.00087 | mg a.i./L | 0.0447 | **51.381** |
| Rainbow trout | 1 | 60-d NOEC | = | 0.00034 | mg a.i./L | 0.0447 | **131.475** |
| Green algae | 1/2 | 96-h $EC_{50}$ | = | 0.05 | mg a.i./L | 0.0447 | 0.894 |
| Duckweed | 1/2 | 14-d $EC_{50}$ | = | 0.14 | mg a.i./L | 0.0447 | 0.319 |
| ***Marine organism*** | | | | | | |
| Quahog Clam | 1/2 | 48-h $LC_{50}$ | = | 0.007 | mg a.i./L | 0.0447 | **6.386** |
| Sheepshead minnow | 1/2 | 96-h $LC_{50}$ | = | 0.030 | mg a.i./L | 0.0447 | **1.490** |
| ***Storage after dip/immersion*** | | | | | | |
| ***Freshwater organisms*** | | | | | | |
| *Daphnia magna* | 1/2 | 48-h $EC_{50}$ | = | 0.011 | mg a.i./L | 0.0085 | 0.772 |
| *Daphnia magna* | 1 | 21-d NOEC | = | 0.00089 | mg a.i./L | 0.0085 | **9.537** |
| Bluegill sunfish | 1/10 | 96-h $LC_{50}$ | = | 0.00087 | mg a.i./L | 0.0085 | **9.756** |
| Rainbow trout | 1 | 60-d NOEC | = | 0.00034 | mg a.i./L | 0.0085 | **24.964** |
| Green algae | 1/2 | 96-h $EC_{50}$ | = | 0.05 | mg a.i./L | 0.0085 | 0.170 |
| Duckweed | 1/2 | 14-d $EC_{50}$ | = | 0.14 | mg a.i./L | 0.0085 | 0.061 |
| ***Marine organism*** | | | | | | |
| Quahog Clam | 1/2 | 48-h $LC_{50}$ | = | 0.007 | mg a.i./L | 0.0085 | **1.213** |
| Sheepshead minnow | 1/2 | 96-h $LC_{50}$ | = | 0.030 | mg a.i./L | 0.0085 | 0.283 |

[1]Endpoints used in the acute exposure risk assessment are derived by multiplying the $EC_{50}$ or $LC_{50}$ from the appropriate laboratory study by the species uncertainty factor.
[2]Expected Environmental Concentration (EEC) = amount of TCMTB leached per day (Table 4) / flow rate of a creek or river (Table 3). EECs are calculated on a per day basis.
[3]Risk Quotient (RQ) = exposure/toxicity. RQ > 1 (in bold) indicates exceedance of LOC (Level Of Concern).

**Table 7 Expected Environmental Concentrations (EECs) and Risk Quotients (RQs) for Freshwater and Marine Organisms Based on Results from the Wood Leaching Study from Rough and Planed Lumber (PMRA# 2645035).**

| Organism | Species Uncertainty Factor | Endpoint1 | | | 1-d EEC2 (mg a.i./L) | RQ3 |
|---|---|---|---|---|---|---|
| ***Freshwater organisms*** | | | | | | |
| *Daphnia magna* | 1/2 | 48-h $EC_{50}$ | = 0.011 | mg a.i./L | 0.0340 | **3.091** |
| *Daphnia magna* | 1 | 21-d NOEC | = 0.00089 | mg a.i./L | 0.0340 | **38.202** |
| Bluegill sunfish | 1/10 | 96-h $LC_{50}$ | = 0.00087 | mg a.i./L | 0.0340 | **39.080** |
| Rainbow trout | 1 | 60-d NOEC | = 0.00034 | mg a.i./L | 0.0340 | **100.000** |
| Green algae | 1/2 | 96-h $EC_{50}$ | = 0.05 | mg a.i./L | 0.0340 | 0.680 |
| Duckweed | 1/2 | 14-d $EC_{50}$ | = 0.14 | mg a.i./L | 0.0340 | 0.243 |
| ***Marine organism*** | | | | | | |
| Quahog Clam | 1/2 | 48-h $LC_{50}$ | = 0.007 | mg a.i./L | 0.0340 | **4.857** |
| Sheepshead minnow | 1/2 | 96-h $LC_{50}$ | = 0.030 | mg a.i./L | 0.0340 | **1.133** |

[1]Endpoints used in the acute exposure risk assessment are derived by multiplying the $EC_{50}$ or $LC_{50}$ from the appropriate laboratory study by the species uncertainty factor.
[2]Risk Quotient (RQ) = exposure/toxicity. RQ > 1 (in bold) indicates exceedance of LOC (Level Of Concern).
[3]Expected Environmental Concentration (EEC) = average concentration calculated in runoff to the storm sewer from lumber with at least 12 hours of covered storage / generic dilution factor of 10 (PMRA# 2647635).

**Table 8 Expected Environmental Concentrations (EECs) and Risk Quotients (RQs) for Freshwater and Marine Organisms Based on Results from the Wood Leaching Study from Packaged Lumber (PMRA# 1231929).**

| Organism | Species Uncertainty Factor | Endpoint1 | | | 1-d EEC2 (mg a.i./L) | RQ3 |
|---|---|---|---|---|---|---|
| ***Freshwater organisms*** | | | | | | |
| *Daphnia magna* | 1/2 | 48-h $EC_{50}$ | = 0.011 | mg a.i./L | 0.0297 | **2.700** |
| *Daphnia magna* | 1 | 21-d NOEC | = 0.00089 | mg a.i./L | 0.0297 | **33.371** |
| Bluegill sunfish | 1/10 | 96-h $LC_{50}$ | = 0.00087 | mg a.i./L | 0.0297 | **34.138** |
| Rainbow trout | 1 | 60-d NOEC | = 0.00034 | mg a.i./L | 0.0297 | **87.353** |
| Green algae | 1/2 | 96-h $EC_{50}$ | = 0.05 | mg a.i./L | 0.0297 | 0.594 |
| Duckweed | 1/2 | 14-d $EC_{50}$ | = 0.14 | mg a.i./L | 0.0297 | 0.212 |
| ***Marine organism*** | | | | | | |
| Quahog Clam | 1/2 | 48-h $LC_{50}$ | = 0.007 | mg a.i./L | 0.0297 | **4.243** |
| Sheepshead minnow | 1/2 | 96-h $LC_{50}$ | = 0.030 | mg a.i./L | 0.0297 | 0.990 |

[1]Endpoints used in the acute exposure risk assessment are derived by multiplying the $EC_{50}$ or $LC_{50}$ from the appropriate laboratory study by the species uncertainty factor.
[2]Risk Quotient (RQ) = exposure/toxicity. RQ > 1 (in bold) indicates exceedance of LOC (Level Of Concern).
[3]Expected Environmental Concentration (EEC) = average concentration measured in pure leachate / generic dilution factor of 100.

## Table 9 Toxic Substances Management Policy Considerations-Comparison to TSMP Track 1 Criteria

| TSMP Track 1 Criteria | TSMP Track 1 Criterion value | | Active Ingredient Endpoints |
|---|---|---|---|
| Toxic or toxic equivalent according to the *Canadian Environmental Protection Act*[1] | Yes | | Yes |
| Predominantly anthropogenic[2] | Yes | | Yes |
| Persistence[3]: | Soil | Half-life ≥ 182 days | $DT_{50}$ of < 2 days in aerobic soil. |
| | Water | Half-life ≥ 182 days | $DT_{50}$ of 2.8 – 3.7 days in total system of aerobic and anaerobic water/sediment systems. |
| | Sediment | Half-life ≥ 365 days | $DT_{50}$ of 2.8 – 3.7 days in total system of aerobic and anaerobic water/sediment systems. |
| | Air | Half-life ≥ 2 days or evidence of long range transport | TCMTB is non-volatile. |
| Bioaccumulation[4] | Log $K_{OW}$ ≥ 5 | | 3.23 |
| | BCF ≥ 5000 | | 184 - 230 |
| | BAF ≥ 5000 | | Not available |
| Is the chemical a TSMP Track 1 substance (all four criteria must be met)? | | | No, does not meet TSMP Track 1 criteria. |

[1] All pesticides will be considered toxic or toxic equivalent for the purpose of initially assessing a pesticide against the TSMP criteria. Assessment of the toxicity criterion may be refined if required (in other words, all other TSMP criteria are met).
[2] The policy considers a substance "predominantly anthropogenic" if, based on expert judgement, its concentration in the environment medium is largely due to human activity, rather than to natural sources or releases.
[3] If the pesticide and/or the transformation product(s) meet one persistence criterion identified for one media (soil, water, sediment or air) than the criterion for persistence is considered to be met.
[4] Field data (for example, bioaccumulation factors [BAFs]) are preferred over laboratory data (for example, bioconcentration factors [BCFs]) which, in turn, are preferred over chemical properties (for example, octanol-water partition coefficent [log $K_{OW}$]).

# Appendix III Label Statements Proposed for Antisapstain Products Containing 2-(thiocyanomethylthio) benzothiazole (TCMTB)

The label amendments proposed below do not include all label requirements for individual products, such as first aid statements, disposal statements, precautionary statements and protective equipment. Information on labels of currently registered products should not be removed unless it contradicts the following label statements.

## PROPOSED STATEMENTS TO PROTECT HUMAN HEALTH

To protect workers, additional personal protective equipment is required on all TCMTB antisapstain product labels. In order to conform to the Exposure Reduction Program, the following statements are proposed to be included on the appropriate product labels in a section entitled **PRECAUTIONS**:

**Antisapstain Product Labels**

- Wear chemical-resistant coveralls over long-sleeved shirt and long pants, chemical-resistant gloves, goggles or face shield, socks, and chemical-resistant footwear when handling the concentrate or during mixing/loading, application, clean-up, maintenance and repair activities.
- Use a NIOSH-respirator if the area is not well ventilated.
- Use a NIOSH-respirator during clean-up, maintenance and repair activities.
- When piling freshly treated lumber or if there is a potential for getting wet by the treating solution or by handling freshly treated lumber, wear chemical-resistant coveralls or a chemical-resistant apron over long-sleeved shirt and long pants, chemical-resistant gloves, socks and chemical-resistant footwear.
- When working in the dip or spray area, wear long-sleeved shirt, long pants, chemical-resistant gloves, socks and boots. Wear goggles or face shield if there is a possibility of splashing.
- Once dry, the treated wood can be handled with cotton or leather gloves.
- Wash hands and face before eating, drinking, smoking and using the toilet. Change clothes daily. Wash contaminated clothing separately from household laundry. Not for use or storage in or around the home. Clean contaminated equipment thoroughly prior to making welding repairs.

## PROPOSED ENVIRONMENTAL STATEMENTS

### A. Environmental Label Statements Proposed for Technical Grade Active Ingredient: TCMTB Liquid Microbiocide Concentrate

#### I) ENVIRONMENTAL PRECAUTIONS:

**TOXIC** to aquatic organisms.

**DO NOT** discharge effluent containing this product into sewer systems, lakes, streams, ponds, estuaries, oceans or other waters.

II) **DISPOSAL:**

Canadian manufacturers should dispose of unwanted active ingredients and containers in accordance with municipal or provincial regulations. For additional details and clean-up of spills, contact the manufacturer or the provincial regulatory agency.

**B. Environmental Label Statements Proposed For End-Use Products: Busan 30 Liquid Microbiocide Concentrate, Busan 1030 Liquid Microbiocide, and Busan 30L Liquid Microbiocide Concentrate**

I) **ENVIRONMENTAL PRECAUTIONS:**

**TOXIC** to aquatic organisms.

II) **DIRECTIONS FOR USE:**

**DO NOT** contaminate irrigation or drinking water supplies or aquatic habitats by cleaning of equipment or disposal of wastes.

This product is **TOXIC** to aquatic organisms. It is not to be used in circumstances that would cause or allow it to enter lakes, streams, ponds, estuaries, oceans or other waters in contravention of federal or provincial regulatory requirements. The requirements of applicable laws should be determined before using the product.

Dip tanks and drip aprons must be roofed, paved and drained to prevent dilution and loss of treatment solution.

Store treated lumber on a roofed drip pad until dripping has ceased. Slope lumber on the drip pad to expedite drainage and to ensure that no puddles remain on the surface of the wood. Manage drippage and other related wastes to prevent release in the environment.

DO NOT expose treated lumber to rains immediately after treatment.

For further information on storage, handling, and disposal of treated wood, contact the manufacturer of this product or the provincial regulatory agency.

III) **STORAGE:**

To prevent contamination store this product away from food or feed.

IV) **DISPOSAL:**

**DO NOT** reuse this container for any other purpose. This is a recyclable container, and is to be disposed of at a container collection site. Contact your local distributor/dealer or

municipality for the location of the nearest collection site. Before taking the container to the collection site:

1. Triple- or pressure-rinse the empty container. Dispose of the rinsings in accordance with provincial requirements.

2. Make the empty, rinsed container unsuitable for further use.

If there is no container collection site in your area, dispose of the container in accordance with provincial requirements.

For information on disposal of unused, unwanted product, or in the case of a spill or spill clean-up, contact the manufacturer or the provincial regulatory agency.

## List of References

### A. LIST OF STUDIES/INFORMATION SUBMITTED BY REGISTRANT

**Chemistry**

| PMRA# | Reference |
|---|---|
| 1863136 | TCM-BUI-1 Analytical Standards, Confidential Appendix to Product Chemistry, tests of water-base and solvent-based TCMTB, Status of Chronic Toxicity Studies, TCMTB Information Release, Protected Data Points, Environmental Fate, Toxicology Testing Program, [CBI removed], Product Identity, Specifications, Manufacturing Method, Quality Control, Physical and Chemical Properties, Sample |
| 1214811 | PARTITION COEFFICIENT OF TCMTB. DATED: MARCH 6, 1982. PERFORMED AT: [Privacy Removed] |
| 1863149 | TCM-BUI-1 TCMTB Samples, Methodology, [CBI Removed] Method for Analyzing TCMTB, [CBI Removed] Method for Analyzing TCMTB and Impurities, Method of Analyzing the [CBI removed] Impurity in TCMTB, Analyzing TCMTB Formulations and Technical Grade, Analytical Method for Residues, [CBI Removed] for Five Impurities |

**Human Health**

| PMRA# | Reference |
|---|---|
| 1145781 | 1989, 2-(thiocyanomethylthio) benzothiazole (TCMTB). 104 week dietary carcinogenicity study in rats with 52 week interim kill (results after 104 weeks), DACO: 4.4.1, 4.4.2 |
| 1151087 | 1969, 90 day sub-acute oral toxicity of TCMTB in beagle dogs, DACO: 4.3.1 |
| 1151089 | 1980, Determination of the mutagenic potential of TCMTB using the CHO/HGPRT Chinese hamster ovary cell forward mutation assay, DACO: 4.5.4 |
| 1151090 | 1980, 90-day subchronic oral toxicity study of TCMTB in rats, DACO: 4.3.1 |
| 1157778 | 1990, 2-(thiocyanomethylthio) benzothiazole (TCMTB). 104 week dietary carcinogenicity study in mice. DACO: 4.4.1, 4.4.2 |
| 1184224 | 1987, TCMTB: 2-(thiocyanomethylthio)benzothiazole. A review of its toxic effects, DACO: 4.1, 5.1, 8.1, 9.1 |

| | |
|---|---|
| 1205067 | 1984, Acute dermal median lethal dose ($LD_{50}$) in the rabbit, DACO:4.2.2 |
| 1205068 | 1986, Evaluation of TCMTB, lot no. 5-13002 in the rat primary hepatocyte unscheduled DNA synthesis assay, DACO: 4.5.4 |
| 1205069 | 1986, Clastogenic evaluation of TCMTB, lot 5-13002 in the in vivo mouse micronucleus assay, DACO: 4.5.4 |
| 1205070 | 1986, A teratology study in rabbits with TCMTB, DACO: 4.5.2 |
| 1228596 | 1988, Acute inhalation toxicity study with TCMTB in the rat, DACO: 4.2.3 |
| 1228597 | 1987, Acute inhalation $LC_{50}$ toxicity study of TCMTB in Sprague-Dawley rats, 4.2.3 |
| 1228598 | 1988, TCMTB. Two generation reproduction study in rats. Interim report, DACO: 4.5.1 |
| 1230093 | 1988, 2-(thiocyanomethylthio) benzothiazole (TCMTB). 52 week dietary toxicity study in dogs, DACO: 4.3.1 |
| 1230422 | 1990, Mutagenicity test on TCMTB in the salmonella/mammalian - microsome reverse mutation assay (Ames test) with confirmatory assay, DACO: 4.5.4 |
| 1232064 | 1988, 2-(thiocyanomethylthio) benzothiazole (TCMTB). 104 week dietary carcinogenicity study in rats with 52 week interim kill (Results after 52 weeks), DACO: 4.4.2 |
| 1232758 | 1988, TCMTB. Two generation reproduction study in rats, DACO: 4.5.1 |
| 1239254 | 1990, Acute oral toxicity study in rats with TCMTB -80, DACO: 4.2.1 |
| 1239255 | 1990, Primary skin irritation study in rabbits with TCMTB -80, DACO: 4.2.5 |
| 1239257 | 1990, 21-day dermal toxicity study in rats with TCMTB -80, DACO: 4.3.4 |
| 1244992 | 1980, Determination of the mutagenic potential of TCMTB using the in vitro Chinese hamster ovary cell sister chromatid exchange assay, DACO: 4.5.4 |
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| 1247665 | 1985, Teratogenicity study of TCMTB in rats, DACO: 4.5.2 |
| 1665704 | 2008, Final Report: field monitoring and re-evaluation of workers dermal exposures to didecyldimethylammonium chloride (DDAC) used in the protection of cut lumber, DACO: 5.4 |
| 1289169 | 2005, Exposure Reduction Program for Antisapstain Chemicals. Green Chain Pullers/Pilers and Cleanup Crew, DACO: 5.14 |
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**Impact on the Environment**

| PMRA# | Reference |
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| 1157769 | Blasberg, J.W., S.L. Hicks and L. Stuerman. 1992. Chronic Toxicity of TCMTB to *Daphnia magna* Under Flow-Through Test Conditions. ABC Laboratories, Inc. Buckman Laboratories International, Inc. Report No. 40089. 56 p., DACO 9.3.1 |
| 1157770 | Falb, L. and R.C. Stewart. 1992. Metabolism of [$^{14}$C]TCMTB in Water and Fish Tissue. ABC Laboratories, Inc. Buckman Laboratories International Report No. 39727. 75p., DACO 9.5.5 |
| 1157771 | Rhodes, J.E. and L. Stuerman. 1992. Early Life-Stage Toxicity of 2-(Thiocyanomethylthio)benzothiazole (TCMTB) to the Rainbow Trout (*Oncorhynchus mykiss*) Under Flow-Through Conditions. ABC Laboratories, Inc. Buckman Laboratories International, Inc. Report No. 40088. 470 p., DACO 9.5.5 |
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| 1157799 | Fathulla, R.N. 1992. Aerobic Aquatic Metabolism of TCMTB-Supplement to the Final Report. Hazleton Laboratories America, Inc. Buckman Laboratories, Inc. Report No. HLA 6015-337. 87 p., DACO 8.2.3.1 |
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## B. ADDITIONAL INFORMATION CONSIDERED

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